MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EEL2026 – POWER TRANSMISSION AND DISTRIBUTION

(LE)

07 MARCH 2016
09:00 am – 11:00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 printed pages with 5 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) List the advantages of bundle conductors in EHV transmission lines. [4 Marks]

(b) A 500 kV three-phase transmission line delivers 300 MW at unity power factor over a distance of 100 km. The transmission efficiency is 98.5 percent at 75°C conductor temperature. If the resistivity of the stranded aluminum conductor is 2.84×10^{-8} Ω-m at 20°C, determine the required conductor diameter. Assume temperature constant, T, of aluminum to be 228. If the diameter of each strand is 0.24 cm, compute the total number of strands in each conductor. [11 Marks]

(c) The conductor of a single-phase 50-Hz line is a solid round aluminum wire having a diameter of 0.5 cm. The conductor spacing is 3.65m. Determine the inductance of the line in mH per km. How much inductance is due to internal flux linkage? Neglect skin effect. What is the effect of the spacing between the conductors on the inductance of the line? [5 Marks]

Question 2

(a) (i) Derive an expression for the inductance of a conductor due to its internal flux. [10 Marks]

(ii) The capacitance per phase of a three-phase 150 km long transmission line having the conductor diameter of d cm is $7.64\text{x}10^{-3}$ μF/km. The spacing between the conductors is 11 m, 16.58 m and 16.58 m. Compute the diameter of the conductor and the charging current, if the line is connected to a 50 Hz and 380 kV source. Assume the line is completely transposed. [6 Marks]

(b) In a 3 core belted cable the capacitance between any two conductors connecting the third conductor to the sheath is measured to be 0.3 μF/km. Determine the charging current drawn by the cable when connected to a 3-phase, 132 kV, 50 Hz supply. [4 Marks]

Question 3

(a) A three-phase short transmission line is supplying a load of 250 MW at 0.8 power factor lagging. The voltage at the receiving end is kept constant at 230 kV. The resistance and reactance per phase of the line are 5 Ω and 15 Ω respectively. Calculate the voltage regulation. [6 Marks]

(b) A 132-kV, 50-Hz, three-phase transmission line is 160 km long. The resistance and reactance are 12.84 Ω/ph and 72.76 Ω/ph respectively. The shunt susceptance is $0.583\text{x}10^{-3}$ S/ph. The receiving end load is 55 MVA at 0.8 power factor lagging. Compute ABCD parameters to find the voltage and power at the sending end and the voltage regulation. [14 Marks]

Question 4

(a) Design a string of suspension insulators having 6 discs, which is to be graded to obtain uniform distribution of voltage across the string. If the pin-to-earth capacitances are all equal to C and the mutual capacitances of the top insulator is 10 C find the mutual capacitance of each unit in terms of C. [10 Marks]

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(b) An overhead conductor is supported by a string of suspension insulators having three similar discs. The voltage across the disc unit connected to the line is 20 kV and that across the middle unit is 15 kV. Determine the string efficiency. [10 Marks]

Question 5

(a) Obtain an approximate expression of the voltage drop (VD) between the sending end and receiving end of a distribution line as;

$$VD = I R \cos\theta + I X \sin\theta$$

R is the resistance and X is the reactance of the line, I is the load current and θ is the receiving end power factor. Show that the maximum voltage drop occurs at a load power factor angle of $\theta_{max} = \tan^{-1}(X/R)$. [4 Marks]

(b) 33-kV voltage is applied to a three-phase distributor having R = 5 Ω and X = 6 Ω per phase. At the end of the line is a balanced load of P MW at 0.707 power factor leading. At what value of P is the load voltage becomes equal to supply voltage? [6 Marks]

(c) A 240V radial distributor is 100 m long and has a resistance of 0.0007 Ω per meter supply and return. Four loads A, B, C and D rated at 30A, 30A, 60A, 80A are fed from the cable at distance of 30 m, 20 m, 25 m and 25 m respectively. Calculate the total current drawn from the supply, the current in the cable between each loads, and the voltage at load D if all the loads are connected. [10 Marks]

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